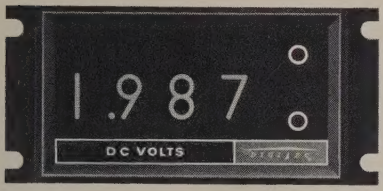
Used on LE 1-1640

model 271A and 272A digital panel meters

s/n 3200 and up



instruction manual
mi-1251E

DigiTec
UNITED SYSTEMS CORPORATION a subsidiary of Monsanto
918 Woodley Road
Dayton, Ohio 45403
(513) 254-6251

Don Gerdeman
Applications Engineer

MP MASTER
MA26223

DIGITEC instrumentation

UNPACKING AND SHIPPING

After unpacking, carefully examine the instrument for physical damage that may have occurred in transit. If any damage is noted, immediately contact United Systems Corporation for further instructions.

If it should become necessary to return the instrument to United Systems Corporation, make certain that at least four inches of padding material surrounds the instrument to prevent damage during shipment. When returning instruments to the factory, give a full description of the failure of the instrument and the mode of operation that was used when the instrument failure occurred. Ship via REA Express, motor truck, or air freight PREPAID to:

United Systems Corporation
918 Woodley Road
Dayton, Ohio 45403

For foreign countries: Please contact your local distributor for instructions.

WARRANTY

"UNITED SYSTEMS CORPORATION guarantees all instruments and accessories to be free from defects in material and workmanship, when subjected to normal use and service. This guarantee is expressly limited to the servicing and/or adjusting of an instrument returned, freight prepaid, to the factory or to the nearest factory authorized Service Center within one(1) year from date of delivery; and to the repairing, replacing or adjusting of parts (excepting lamps, fuses and batteries) which upon examination shall be found defective. UNITED SYSTEMS CORPORATION assumes no liability in connection with the sale of such products beyond that specifically provided hereinabove."

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Specifications are subject to change without notice.

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Digital Panel Meter
Instruction Manual
MI-1251E

FOR MODELS
271A-1, 271A-2, 271A-3, 271A-4, 271A-5,
272A-1, 272A-2, 272A-3, 272A-4, 272A-5.

1. GENERAL INFORMATION

The DigiTec Series 270A Readouts are precision, miniature digital instruments. They are capable of accurately indicating any measurable parameter that is expressed by, or can be transduced into, a DC voltage or current.

1.1 Features

Models of these digital readouts are available for a wide range of voltages and currents with resolution as low as 100 microvolts or 10 nanoamps. Other important features are:

High accuracy
Non-blinking display
BCD option
Reading retention
Small panel space
Completely self contained

1.2 Applications

Some of the typical applications for the Series 270A are:

Replacement of moving coil meters
Monitoring voltage or current
Output indicators for signal conditioners for such parameters as pressure, strain or temperature
Analog to digital conversions for use with printer, punches or process control.

1.3 Technical Specifications

Range		Model No.	Resolution	Input Impedance	Accuracy
Millivolts	00.0-199.9	271A-1	100 μV	100MΩ	0.1% of reading ±1 digit
Volts	.000-1.999	271A-2	1 mV	100MΩ	
	0.00-19.99	271A-3	10mV	10MΩ	
	00.0-199.9	271A-4	100 mV	10MΩ	
	000.-1000.	271A-5	1 V	10MΩ	
				Shunt Impedance	0.2% of reading ± 1 digit
Microamperes	0.00-19.99	272A-1	10 nA	10KΩ	
	00.0-199.9	272A-2	.1 μA	1KΩ	
Milliamperes	.000-1.999	272A-3	1 μA	100Ω	
	0.00-19.99	272A-4	10 μA	10Ω	
	00.0-199.9	272A-5	.1 mA	1Ω	

Reading Time	0.6 sec. maximum to 99.9% of DC step change
Reading Rate	Line frequency
Display	Ultra long life NIXIES®
Error Lamp	Indicates over range or reverse polarity input
Isolation	500 VDC, input low to ground
Rejection	Normal Mode 40 db @ 60 Hz Common Mode 80 db @ 60 Hz
Temp. Coefficient	± 50 PPM/^{o}C
Operating Ambient	60^{o} to 100^{o} F
Reading Retention	Circuit opening to hold indefinitely
Overload Protection	± 100 volts on Model 271A-1 & 271A-2 ± 1000 volts on Models 271A-3, 271A-4 & 271A-5 1 watt dissipation for Models 272A-1, 2, 3, 4 & 5
BCD output ('N' Option) Logic	
1	+4V with 3.6K impedance
0	+0.4V max. current sink: 5mA
Error	Logic "1" with visual indication
Power Requirements	105/125V 50/60Hz, 5.5VA 210/250V ('S' Option)
Net Weight	1 pound 9 ounces
Shipping Weight	2-1/4 pounds
Output Connector	Cinch 251-12-36-160 (furnished)

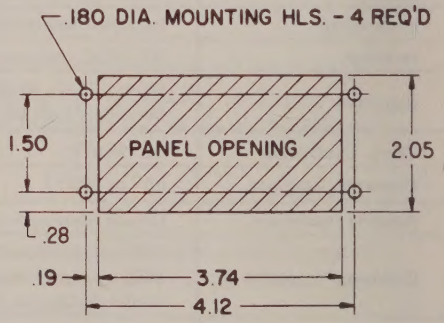
1.4 Precautions

The rear connector is keyed with the pin numbers on top. Failure to mount the connector correctly may result in permanent damage to the instrument. To operate these instruments, earth ground as well as high and low power must be supplied to the connector. Unstable readings may occur if the earth ground connection is deleted.

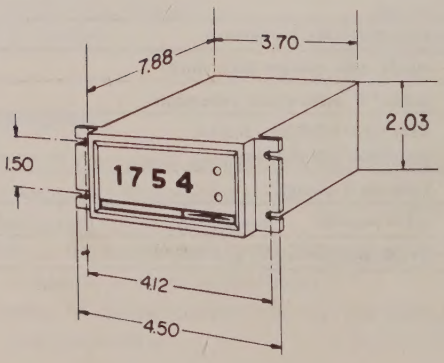
These instruments incorporate a 'store' feature that may be used to retain a digital reading. This feature must be defeated with a jumper for normal operation (See Section 3.2).

2. INSTALLATION

These instruments are designed to be permanently mounted into a panel using No. 6 Screws or Studs. The instrument must be inserted into the cutout from the rear. Figure 1 illustrates the instrument opening and mounting dimensions, while Figure 2 illustrates the over all dimensions.



Panel Template
Figure 1

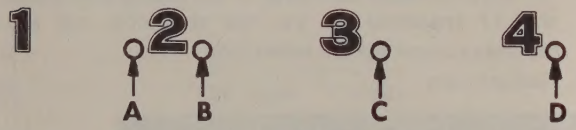


Outline Drawing
Figure 2

2.1 Decimal Point Selection

Decimal points are factory installed in the location designated by the model number. It is strongly recommended that the decimal point not be changed in the field; however, it can be changed if extreme caution is observed. The decimal point can be in any one of four positions: A, B, C or D (See Figure 3).

To change the decimal point location, remove the solder from the undesired pad location A, B, C or D (see Figure 8, View 1) with a small, low temperature iron and apply a drop of solder to the pad corresponding to the new decimal location.



Decimal Point Position
Figure 3

3. OPERATING INSTRUCTIONS

3.1 Power Connection

The power applied to these digital readouts can be either 115 or 230 VAC, depending on internal connections made at the factory. Units wired for 230 volt operation are designated with an 'S' suffix. For either input voltage, Pin 'B' is power high, Pin 'A' is power low and Pin 'C' is earth ground. Readings may be unstable if earth ground is not used.

3.2 Reading Retention

Some applications, such as recording of data, require that the normal sampling rate be interrupted and the last digital reading stored. This can be accomplished by opening the connection between Pins 1 (store) and 2 (common) of the rear connector.

3.3 Warm-up Period

For maximum accuracy, these instruments should be allowed to warm up for 20 minutes. The instrument, however, is operable immediately upon turn-on with a stabilization error of approximately one digit.

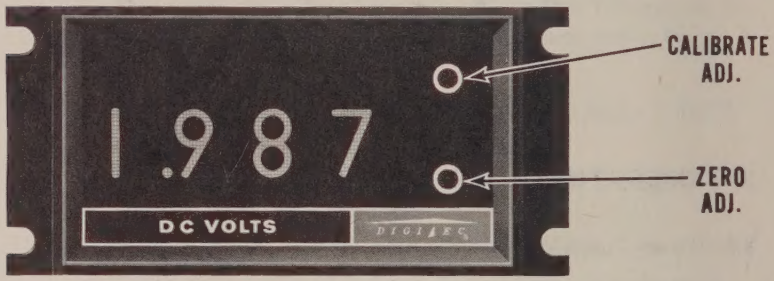
3.4 Zero Adjustment (See Figure 4)

The zero adjustment, located on the front panel, is used to zero out internal offsets in the instrument and offset voltages that may be present in the input signal.

3.5 Calibrate Adjustment (See Figure 4)

All instruments are calibrated at the factory to meet or exceed the specification outlined in Section 1.3 of this manual. If recalibration is desired, the following procedure should be used.

1. Allow 20 minutes warm up and adjust zero.
2. Apply full scale input voltage or current to Pins 12 (positive) and 11 (negative) on the rear connector and adjust the calibrate control for full scale.
3. Recheck zero



Front View of Instrument
Figure 4

4. CIRCUIT DESCRIPTION (See Figure 6)

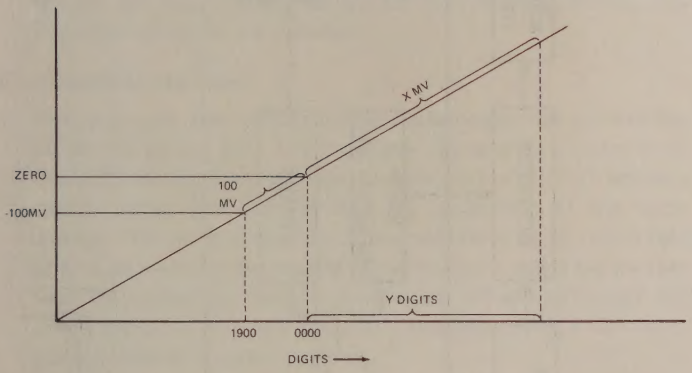
At the beginning of a sampling cycle, a ramp gate is initiated and the solid state switch is set to monitor the internal reference voltage. The ramp gate initiates a ramp voltage and a reset pulse. The ramp voltage is fed to a detector where it is compared to a reference voltage and the reset pulse is used to preset the digital section to 1900.

When coincidence of the reference and ramp voltage occurs, the Schmitt trigger 'fires', the flip-flop changes state, and the clock starts running. The pulses from the clock are then fed into the digital section. When the flip-flop changes states, the solid state switch also changes positions and begins monitoring the voltage from the input filter instead of the reference voltage. This input voltage is now compared to the same ramp. When

coincidence again occurs, the flip-flop returns to the original state, the clock stops, and the solid state switch returns to the reference position.

To provide an extremely stable digital instrument, the same comparator is used for both the reference and the unknown voltage. Since a Schmitt trigger cannot 'fire' reliably at zero volts and again at one millivolt, the reference is set at minus 100 millivolts, with the counter preset to 1900 digits. Using this arrangement an artificial, but highly stable, zero will be produced. Since minus 100 millivolts equals 1900 digits, zero volts can be made to read 2000 digits which resets to 0000. Then by using similar triangles, it can be seen that: (See Figure 5)

$$\frac{100MV}{100\ Digits} = \frac{X\ MV}{Y\ Digits}$$



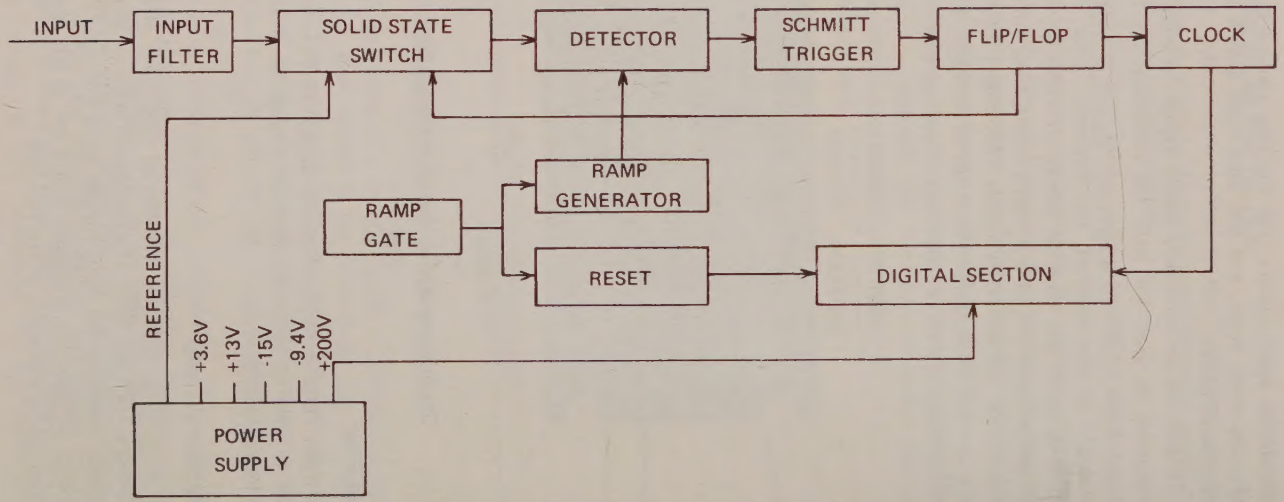
Graphic Representation of Artificial Zero
Figure 5

4.1 Input Filter

The input filter consists of a two section R-C circuit. A clipper diode is used to limit the positive voltage to a safe level for over-voltage protection.

4.2 Solid State Switches

The solid state switches consists of two field effect chopper transistors, Q24 and Q23. The transistors are arranged so that one transistor monitors the input voltage while the other monitors the reference voltage. The transistor that is 'on' at any specific time is determined by the status of the flip-flop.



Block Diagram
Figure 6

4.3 Detector

The detector consists of a single PNP transistor which compares the input and reference voltage to the ramp voltage. When coincidence occurs an output is produced which is fed to the Schmitt trigger.

4.4 Schmitt Trigger

The Schmitt trigger, preceded by emitter follower Q19, consists of transistors, Q17 and Q18. When Q18 is 'on', Q17 will be 'off'. For each turn-off of Q17 the flip-flop changes states.

4.5 Flip-Flop

The flip-flop consists of Q15, Q16 and associated components. When Q16 is 'off', the FET chopper, Q24, is 'on' and the input voltage is fed to the detector. When Q15 is 'off', the chopper Q23 will be 'on' and Q24 will be turned 'off', thereby, feeding the reference voltage to the detector.

4.6 Ramp Gate and Reset

The ramp gate and reset are initiated every other half cycle of the 50/60 Hz power line. The transistor Q3 receives a pulse from diode D7 and produces an output which drives Q22. Q22 acts as a switch across C16 and controls the generation of the ramp voltage. This ramp voltage is initiated continuously at a 60Hz rate as long as a jumper is installed between Pins 1 and 2 on the rear terminals. When this jumper is removed, Q4 will be turned 'on' which turns Q3 'on' and Q22 'off', thus preventing a new ramp voltage from being generated.

The reset is used to preset the digital section at the beginning of a sampling cycle. The reset pulse is derived by differentiating the ramp gate with C1, R6, and Q2.

4.7 Ramp Generator

The ramp generator consists of a high gain operational amplifier with capacitive feedback. The amplifier then acts as an integrator, thus converting a constant current into a highly linear ramp voltage.

4.8 Clock

The clock consists of a gated Colpitts oscillator, a buffer and final amplifier stage. The oscillator is turned on when Q15, in the flip-flop section, is off; thus, allowing the clock to be initiated

by the coincidence of the reference and ramp voltages, and terminated by the coincidence of the input voltage and ramp voltage.

4.9 Digital Section

The digital section consists of integrated circuit BCD counters, BCD to decimal converters, Nixie tubes, and drivers for the error and 1000 bit indicators. The output from the clock is fed into the BCD counter which converts the incoming 'clock' pulses into BCD logic output. The BCD output is then decoded into decimal information and displayed on the Nixie tubes. The 1000 digit and error bit consists of neon lamps driven by discrete transistors.

4.10 Power Supply

There are five power supplies in this instrument. The most important supply is the minus 9.4 volt source which is used to reference the -15 and +4.5 volts supplies as well as providing a stable reference for zero.

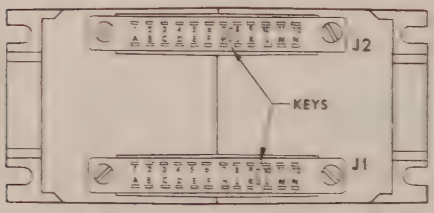
The +13 volt supply uses a simple R-C filter with a zener diode in the output.

The +200 volt supply uses only a single diode and produces half wave pulsating DC. This half wave DC allows the counters to count without displaying on the negative half cycle, and to display the stored digital reading on the positive half cycle.

5. REAR CONNECTOR (Cinch 251-12-36-100)

Function J1	Pin
Input (positive)	12
Signal ground (negative)	11
High line	B
Low line	A
Earth ground	C
Store	1
Common	2
Not connected	3, 4, D

Function J2 "NB" Option Only	Pin
BCD 1	5
BCD 2	4
BCD 4	3
BCD 8	B
BCD 10	10
BCD 20	9
BCD 40	N
BCD 80	A
BCD 100	6
BCD 200	E
BCD 400	D
BCD 800	C
BCD 1000	L
BCD Error	M
BCD Common	2



Rear View of Instrument Figure 4

6. SERVICE AND TROUBLESHOOTING

6.1 Necessary Service Equipment

1. A standard VTVM of 3% accuracy or better.
2. An oscilloscope capable of measuring 550KHz.
3. Voltage or current standard with accuracy of 0.01% or better, such as a Digitec Model 311 calibrater.

If service equipment of the required accuracy is not available, the instrument may be returned to United Systems Corporation for repair.

6.2 Repair Procedure

The Series 270A instruments have extremely high input impedance. To maintain this impedance, and thus the stability of the instrument, the printed circuit board must be thoroughly cleaned and coated after any repair in the input circuitry. To make any repairs in this section, the following procedure must be used.

1. Remove the plastic coating from the board with Methylene Chloride.
2. Make repairs as necessary with a small low temperature iron.
3. Clean board — protect pots to prevent removal of lubricants.
   (a) Salt base fluxes — wash with three changes of warm water or one long cycle of a board washer.
   (b) Resin flux — remove with Toluol.
4. Clean board with Freon TE.
5. Spray with Urethene seal coat (CRC No. 2049 or equivalent).
6. Wait 24 hours before reapplying power to board.

6.3 Fuse Replacement

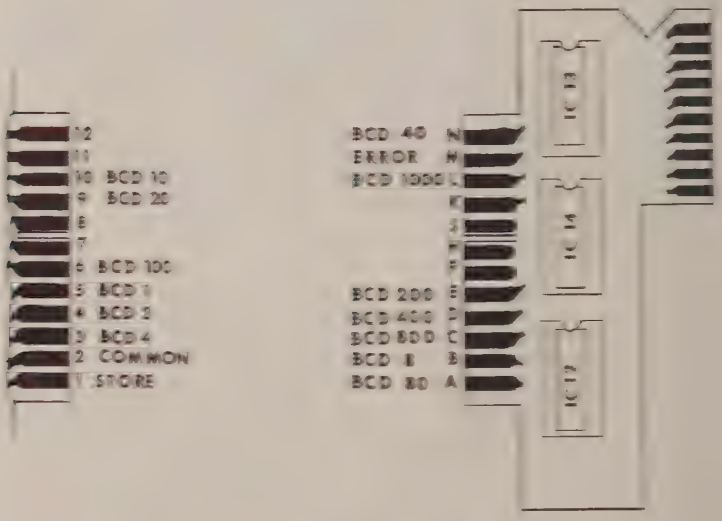
This instrument contains a 1.8 amp fuse, which may fail as a result of severe line transients or by component failure within the instrument. If the replacement fuse fails, the circuit should be checked thoroughly. A HIGHER CURRENT FUSE SHOULD NEVER BE SUBSTITUTED. The fuse is located on the transformer using pigtailed leads.

6.4 TROUBLESHOOTING HINTS

Symptoms	Possible Cause
Unit will not sample	Defective Q4, Q3, Q22
All numbers in Nixie lit simultaneously	Defective Q2, IC2, 3, 4
Incorrect number displayed	IC 2, 3, 4, 6, 7, 8
Error lamp inoperative	IC5, Q1, L1
1000 Bit lamp inoperative	IC5, Q5, I2
Digital Readout displays 1900	Defective IC2, Q12, 16, 23, Loose connection on Zero or Cal. Pot.
All numbers in Nixie lit simultaneously	Defective IC2, 3, 4, Q15, 24
Incorrect number displayed	IC1, 2, 3, 4, 6, 7, 8, Q2, 3, 4, 22
Improper BCD Output	IC2, 3, 4, 5, Loose BCD cable

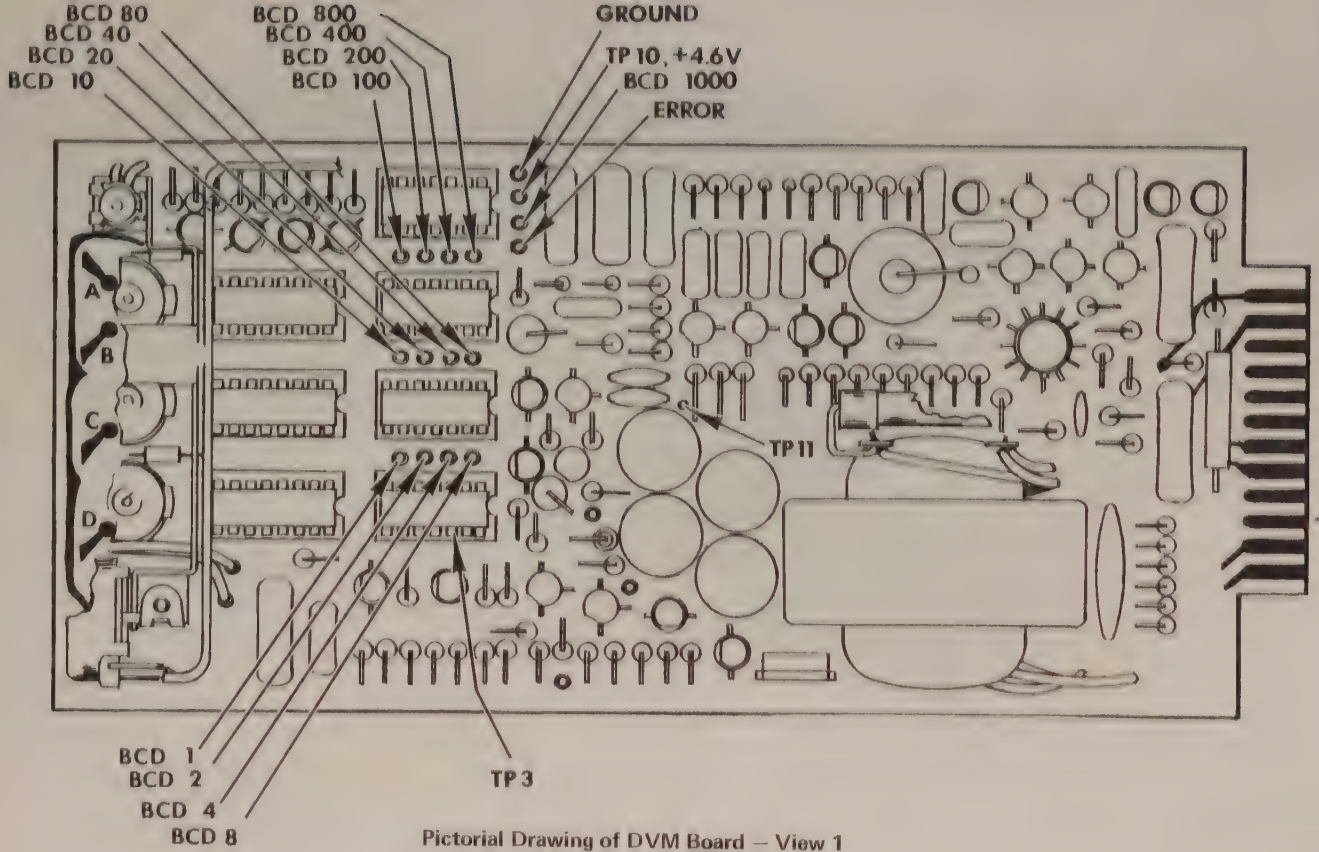
It is not recommended that Nixie tubes be replaced in the field.

For typical waveshapes and voltages, see Figure 9



Pictorial Drawing of "NB" Option Board

Figure 7



Pictorial Drawing of DVM Board – View 1

Figure 8

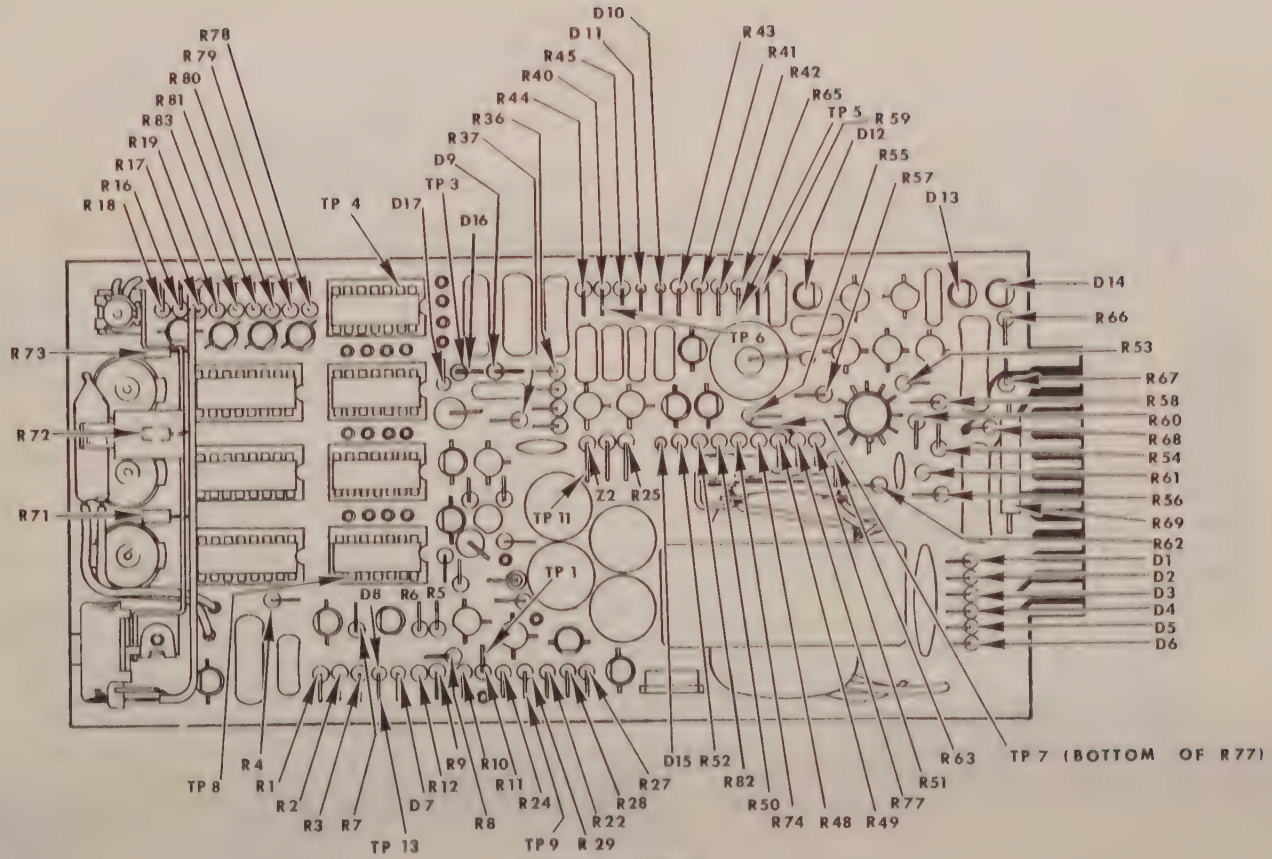


Figure 8 — View 2

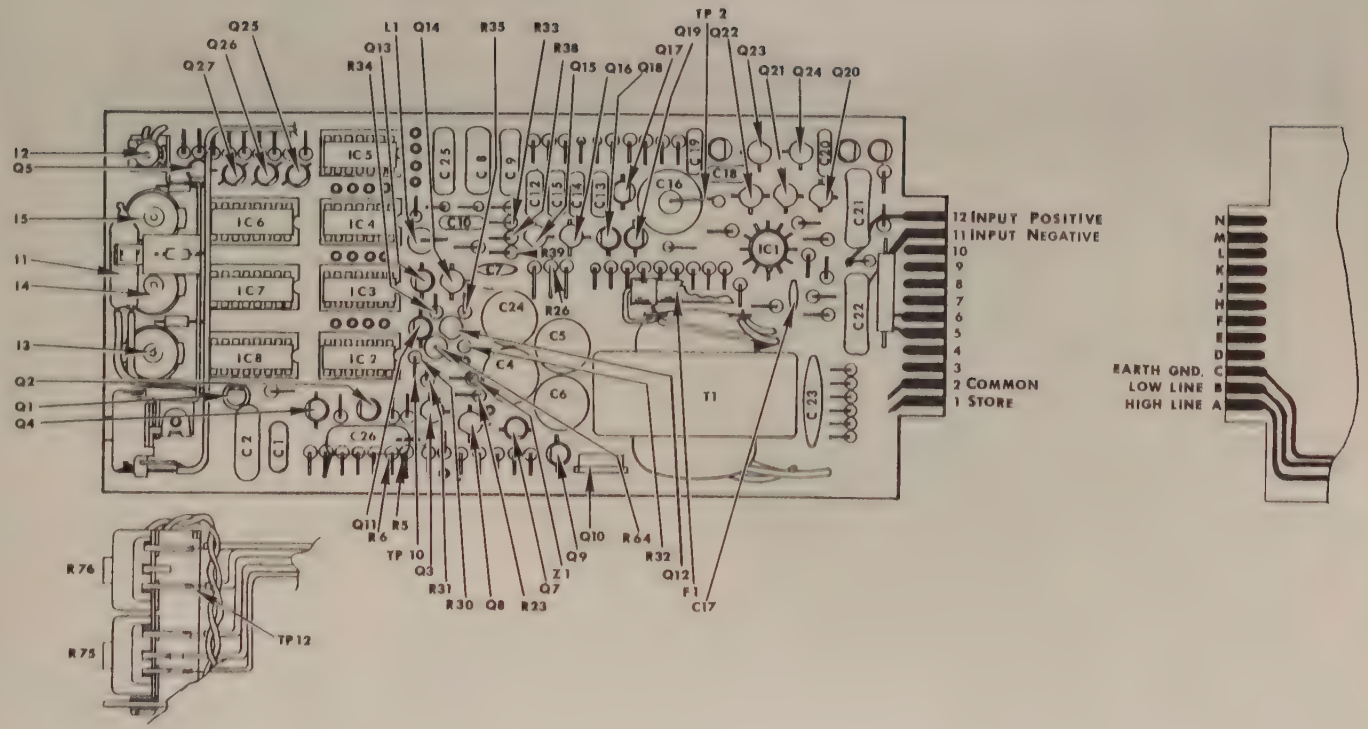


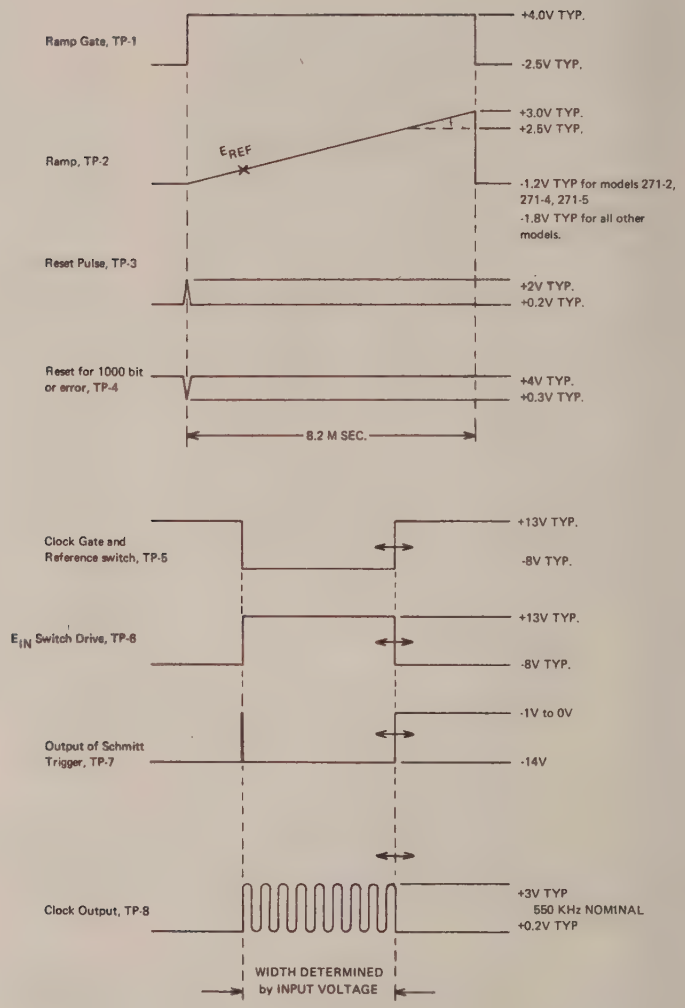
Figure 8 – View 3

Parts List for Series 270A Digital Panel Meters

SYMBOL	DESCRIPTION	STOCK NUMBER
R1, 18, 57	Resistor, Carbon, 470K, 1/4W, 10%	55-10101JK470
R2, 3, 28	Resistor, Carbon, 18K, 1/4W, 10%	55-10101JK018
R4, 19, 50	Resistor, Carbon, 6.8K, 1/4W, 10%	55-10101JK006R8
R5	Resistor, Carbon, 150 ohm, 1/4W, 10%	55-10101JA150
R6, 8, 34, 51, 78	Resistor, Carbon, 10K, 1/4W, 10%	55-10101JK010
R7, 74	Resistor, Carbon, 150K, 1/4W, 10%	55-10101JK150
R9, 10, 38, 60	Resistor, Carbon, 27K, 1/4W, 10%	55-10101JK027
R11, 16, 17	Resistor, Carbon, 33K, 1/4W, 10%	55-10101JK033
R12	Resistor, Carbon, 56K, 1/2W, 10%	55-10102JK056
R22, 27	Resistor, Carbon, 3.3K, 1/4W, 10%	55-10101JK003R3
R23	Resistor, Fixed, 4.64K, 3/4W, 1%	55-10111ELK004R64
R24	Resistor, Fixed, 3.32K, 3/4W, 1%	55-10111ELK003R32
R25	Resistor, Carbon, 330 ohm, 1/2W, 10%	55-10102JA330
R26, 79, 80, 81	Resistor, Carbon, 2.2K, 1/4W, 10%	55-10101JK002R2
R29	Resistor, Precision, 471 ohm, 1W, 0.1%	55-10121BDA471
R30	Resistor, Carbon, 470 ohm, 1/4W, 10%	55-10101JA470
R31	Resistor, Carbon, 1K, 1/4W, 10%	55-10101JK001
R32	Resistor, Carbon, 12K, 1/4W, 10%	55-10101JK012
R33, 35, 49, 52, 77	Resistor, Carbon, 4.7K, 1/4W, 10%	55-10101JK004R7
R36, 42, 44	Resistor, Carbon, 5.6K, 1/4W, 10%	55-10101JK005R6
R37	Resistor, Carbon, 220 ohm, 1/4W, 10%	55-10101JA220
R39, 48	Resistor, Carbon, 15K, 1/2W, 10%	55-10102JK015
R40, 41	Resistor, Carbon, 22K, 1/4W, 10%	55-10101JK022
R43, 45	Resistor, Carbon, 39K, 1/2W, 10%	55-10102JK039
R53		
Models 271A-1, 3 272A-1, 2, 3, 4, 5 only	Resistor, Carbon, 120K, 1/4W, 10%	55-10101JK120
R54		
Models 271A-1, 3 272A-1, 2, 3, 4, 5 only	Resistor, Precision, 1.2K, 1W, 0.1%	55-10121BDK001R2
R55	Resistor, Precision, 28.8K, 1/8W, 0.1%	55-09476
R56	Resistor, Film, Factory Selected	
R58	Resistor, Precision, 9.75K, 1W, 0.1%	55-10121BDK009R75
R59	Resistor, Carbon, 120K, 1/2W, 10%	55-10102JK120
R61		
Models 271A-1, 3 272A-1, 2, 3, 4, 5	Resistor, Precision, 3.96K, 1W, 0.1%	55-10121BDK003R96
Models 271A-2, 4, 5	Resistor, Precision, 2.38K, 1W, 0.1%	55-10121BDK002R38
R62	Resistor, Precision, 15.7K, 1W, 0.1%	55-10121BDK015R7
R63	Resistor, Film, 402 ohm, 3/4W, 1%	55-10111EJA402
R64		
Models 271A-1, 3 272A-1, 2, 3, 4, 5	Resistor, Film, 433.8K, 3/4W, 1%	55-10111EJK433R8
Models 271A-2, 4, 5	Resistor, Film, 43.38K, 3/4W, 1%	55-10111EJK043R38
R65	Resistor, Film, 1.43K, 3/4W, 1%	55-10111ELK001R43
R66	Resistor, Carbon, 180K, 1/4W, 10%	55-10101JK180
R67		
Models 271A-1, 2, 5 272A-1, 2, 3, 4, 5	Resistor, Carbon, 100K, 1/4W, 10%	55-10101JK100
Models 271A-3, 4	Resistor, Carbon, 22K, 1/4W, 10%	55-10101JK022
R68		
Models 271A-3, 4 only	Resistor, Film, 9.9Meg, 3/4W, 0.5%	55-10165BJM009R9
Models 271A-5 only	Resistor, Film, 9.99Meg, 3/4W, 0.5%	55-09471
Models 272A-1, 2, 3, 4, 5 only	Jumper	
R69		
Models 271A-3, 4	Resistor, Film, 100K, 3/4W, 0.5%	55-10111DJK100

Parts List for Series 270A Digital Panel Meters (cont.)

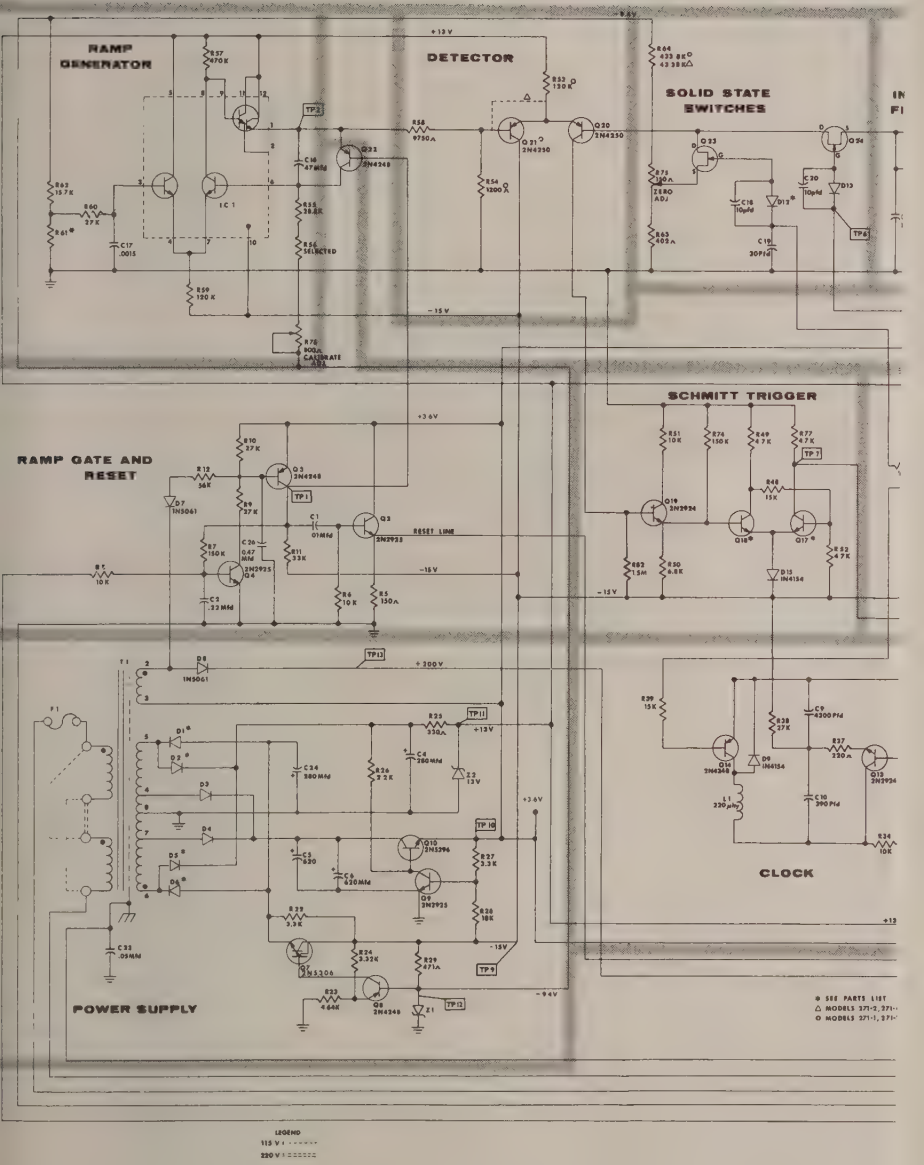
SYMBOL	DESCRIPTION	STOCK NUMBER
R69		
Models 271A-5, 272A-1	Resistor, Film, 10K, 3/4, 0.5%	55-10121DDK010
Model 272A-2	Resistor, Precision, 1K, 1W, 0.5%	55-10121DDK001
Model 272A-3	Resistor, Precision, 100 ohm, 1W, 0.5%	55-10121DDA100
Model 272A-4	Resistor, Precision 10 ohm, 1W, 0.1%	55-10121DDA010
Model 272A-5	Resistor, Precision, 1 ohm, 1W, 0.5%	55-10121DDA001
R71, 72, 73	Resistor, Carbon, 8.2K, 1/4W, 10%	55-10101JK008R2
R75	Resistor, Variable Wire, 150 ohm, 2W, 20%	55-10152KA150
R76	Resistor, Variable Wire, 800 ohm, 2W, 20%	55-10152KA800
R82	Resistor, Carbon, 1.5Meg, 1/2W, 10%	55-10102JM001R5
R83	Resistor, Carbon, 680 ohm, 1/2W, 10%	55-10102JA680
C1	Capacitor, Mylar, 0.01μfd @ 400VDC	56-10205AYA103J4
C2, 21, 22	Capacitor, Mylar, 0.22μfd @ 200VDC	56-10206BYB224J2
C4, 24	Capacitor, Electrolytic, 280μfd @ 25VDC	56-10216BH287N25
C5, 6	Capacitor, Electrolytic, 620μfd @ 10VDC	56-10216BH 627N10
C7, 17	Capacitor, Ceramic, 0.0015μfd @ 1000VDC	56-10215A152JT10
C8, 25	Capacitor, Mylar, 0.1μfd @ 200VDC	56-10205BYB104J2
C9	Capacitor, Mica, 4300pf @ 500VDC	56-10210C432FL5
C10,	Capacitor, Mica, 390pf @ 500VDC	56-10210A391FL5
C12, 13	Capacitor, Mica, 150pf @ 500VDC	56-10210A151HL5
C14, 15	Capacitor, Mica, 500pf @ 500VDC	56-10210A501HL5
C16	Capacitor, Pholystyrene, 0.47μfd @ 100VDC	56-10208EY474FL1
C18, 20	Capacitor, Mica, 10pf @ 500 VDC	56-10210A100JL5
C19	Capacitor, Mica, 30pf @ 500VDC	56-10210A300JL5
C23	Capacitor, Ceramic, 0.05μfd @ 600VDC	56-10215H503KT6
C26	Capacitor, Mylar, 0.47μfd @ 100VDC	56-10206BYB474K1
L1	Choke, Inductor	42-09468
D1, 2, 3, 4, 5, 6, 17	Diode, Power, 0.8 amp @ 100PIV	40-07787-01
D7, 8	Diode, Power, 1N5061	40-09463
D9, 10, 11, 15, 16	Diode, Signal, 1N4154	40-09297
D12, 13, 14	Diode, Clipper	40-07199-01
Z1	Diode, Zener, 1N2166A	40-09069-01
Z2	Diode, Zener, 13V	40-09219-07
Q1, 5	Transistor, High voltage, 2N3877A	40-11594
Q2, 4, 9	Transistor, Signal, 2N2925	40-04233-05
Q3, 8, 12, 14, 15, 16, 22	Transistor, Signal, 2N4248	40-09437
Q7	Transistor, Darlington, 2N5306	40-09277
Q10	Transistor, Power, 2N5296	40-09145
Q11, 17, 18	Transistor, Signal, 2N2922	40-04233-02
Q13, 19	Transistor, Signal, 2N2924	40-04233-04
Q20	Transistor, Signal, 2N4250 Selected	40-11253
Q21		
Models 271A-1, 3 272A-1, 2, 3, 4, 5	Transistor, Signal, 2N4250	40-09952
Q23, 24	Transistor, Field Effect	40-07963
Q25, 26, 27	Transistor, Signal, 2N2923	40-04233-03
IC1	Integrated circuit	40-09464
IC2, 3, 4	Integrated circuit, counter	40-07516
IC5	Integrated circuit, J-K flip-flop	40-07485
IC6, 7, 8	Integrated circuit, decoder	40-07510
IC12, 13, 14 "NB" Option only	Integrated circuit	40-11830
L1, 2	Lamp, Neon	52-07654
I 3, 4, 5	Lamp, Nixie	49-09469
F1	Fuse, 1/8 amp, slow blow	52-09749-01
T1	Transformer, power	42-09460
	Enclosure	30-09266A
	Window	32-09227
	Connector	51-07548-12



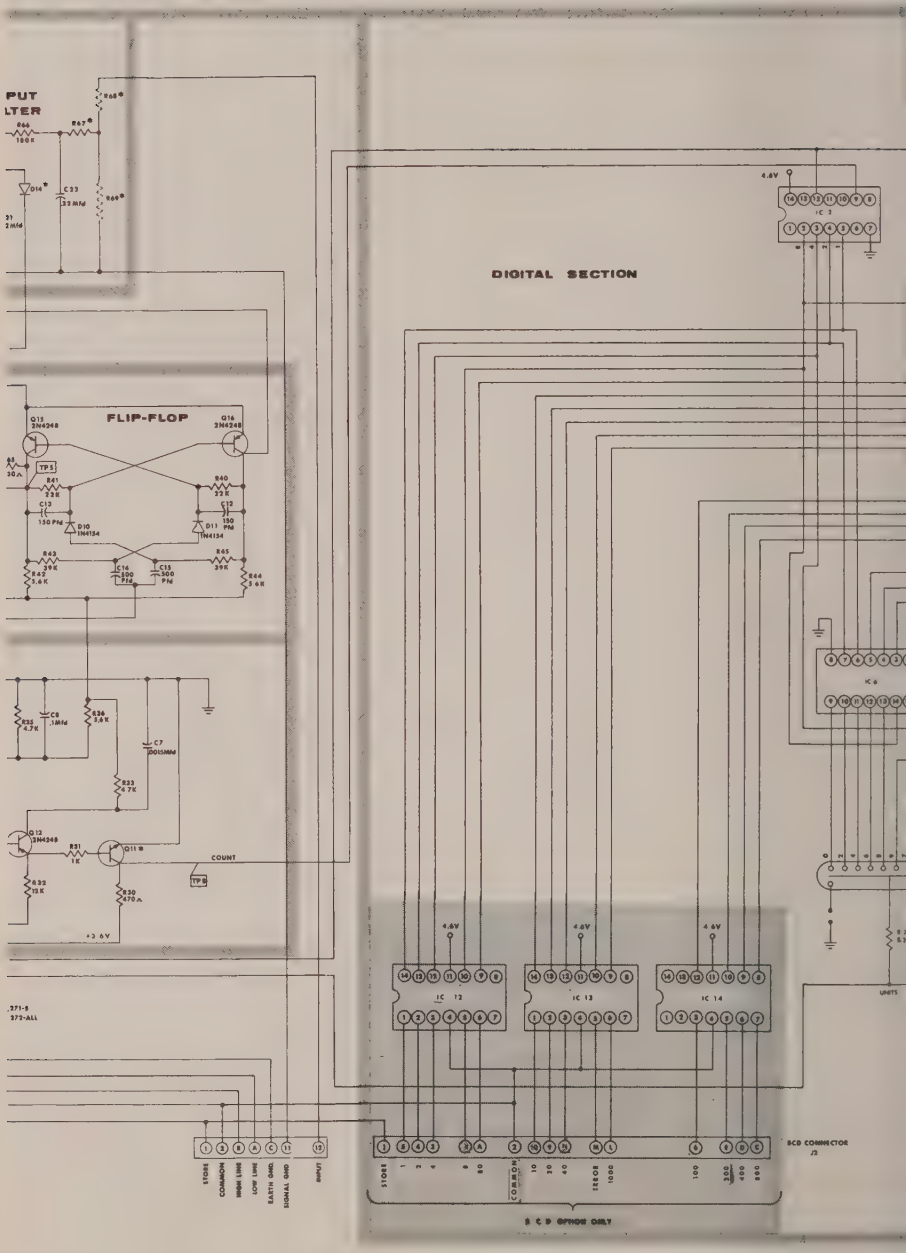
	TYPICAL	RANGE
TP- 9	- 15.0 Volts	14.5 to 15.5
TP-10	+ 3.6V Volts	3.2 to 4.0
TP-11	+13.0 Volts	11.5 to 14.5
TP-12	- 9.4 Volts	9.2 to 9.6
TP-13	+238V Peak	170 to 270

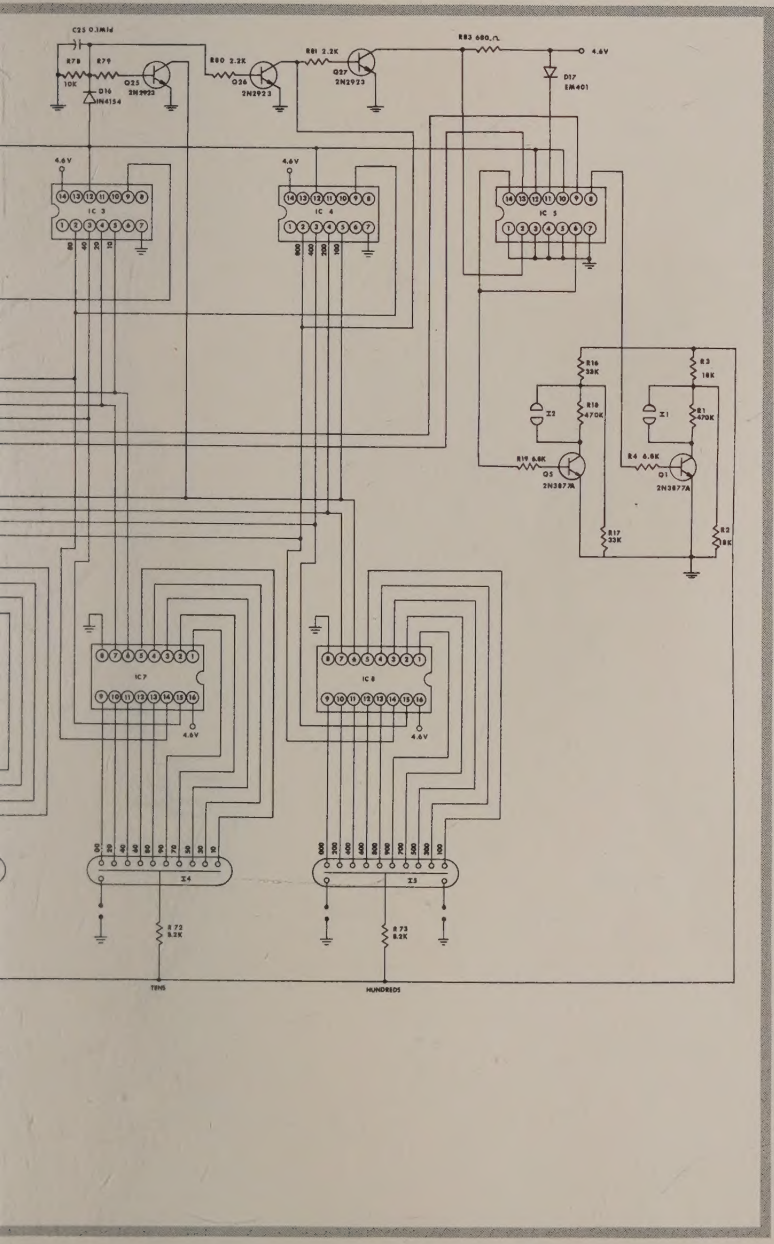
Typical Test Point Waveforms and Voltages

Figure 9



Schematic Diagram
Figure 10


DIGITAL SECTION
FLIP-FLOP
Q15 2N4248
Q16 2N4248
TP5
R41 22K
R40 22K
C13 150 PM
C12 150 PM
D10 1N4154
D11 1N4154
R43 39K
R42 5.6K
C14 500 PM
C15 500 PM
R65 39K
R44 5.6K
R33 4.7K
C8 .1MFd
R38 5.6K
C7 .0015MFd
R23 4.7K
Q12 2N4248
R31 1K
Q11
COUNT
TP6
R32 15K
R30 470Ω
+3.6V
4.6V
IC 12
IC 13
IC 14
IC 2
IC 6
UNITS
STORE
COMMON
MSM LINE
LSM LINE
EARTH GND.
SIGNAL GND.
INPUT
BCD CONNECTOR
STORE
COMMON
1
2
4
8
80
10
20
40
80 BCD
1000
100
200
400
800
B C D OPTION ONLY


C25 0.1MFd
R78 10K
R79
D16 1N4154
Q25 2N3922
R80 2.2K
Q26 2N2923
R81 2.2K
Q27 2N2923
R83 680Ω
4.6V
D17 EM401
IC 3
IC 4
IC 5
R16 33K
R3 18K
Z2
R18 470K
Z1
R21 470K
R19 6.8K
Q5 2N3877A
R4 6.8K
Q1 2N3877A
R17 33K
R2 18K
IC7
IC 8
Z4
Z3
R72 8.2K
TENS
HUNDREDS

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Printed in U.S.A.